

Slippery Slope

Reporting Category Equations and Inequalities

Topic Writing equations of lines

Primary SOL A.6a The student will graph linear equations and linear inequalities in two variables, including determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined.

Related SOL A.7d

Materials

- Linking cubes
- Graph paper (optional)

Vocabulary

coordinate (earlier grades)

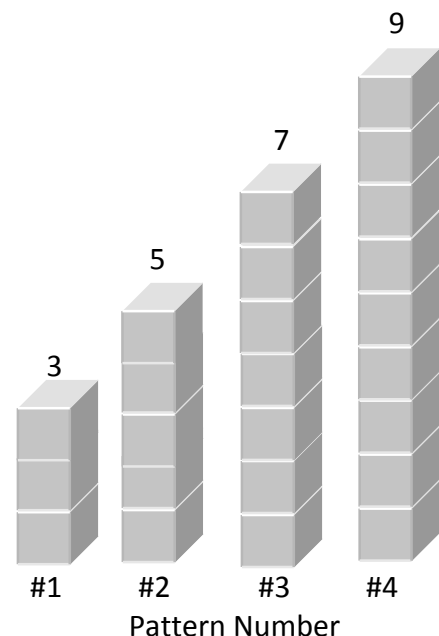
slope, rate of change, equation of a line, y-intercept, and x-intercept (A.6)

dependent variable (A.7)

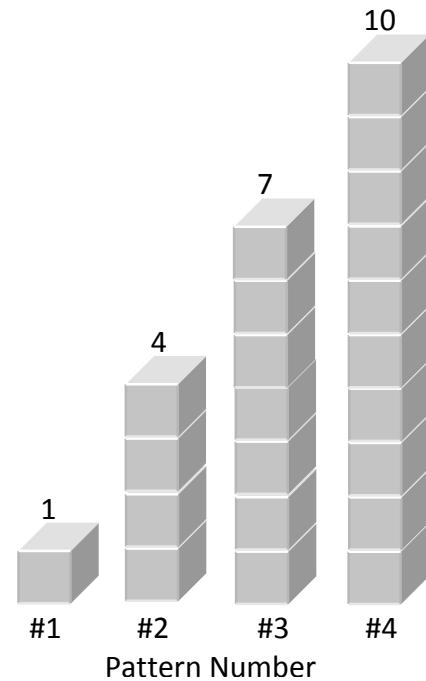
Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

PART 1: CONTINUING A PATTERN

1. Display the sequence of towers shown at right, and ask students to draw the next 3 towers.
2. To learn whether students can generalize this activity, ask them to figure out how many blocks would be in tower #10 *without* drawing all the intervening towers. (Note: Some students will reason that because the number of blocks increases by 2 from tower to tower and because 6 more towers are required to get to tower #10, they just need to add 12 to the number of blocks in tower #4. Other students may notice that the number of blocks in each tower is 1 more than twice the pattern number for the tower.)
3. Ask students how they could describe the pattern symbolically. (Note: This way of viewing the pattern does not encourage thinking about the change from one tower to the next. You need to ask questions to help students focus on building the formula on the basis of change from one to the next.)
4. Ask students how many blocks would be in tower #0. Then, ask, “If you start with the blocks in tower #0, how many additional blocks would you need to build tower #3?” (Note: This focuses on the additional 3 sets of 2 blocks needed to build tower #3.)

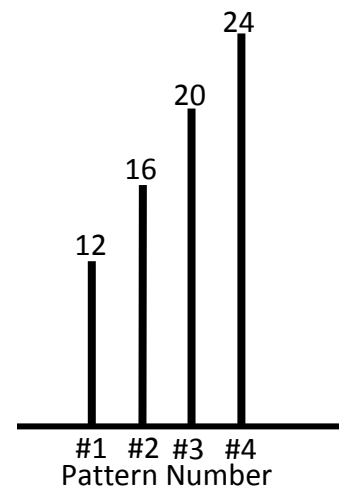


5. Ask students how many blocks would be in tower #8.
(Note: Students will probably add 8 sets of 2 blocks to the number in tower #0. This answer will help students see the 2 in $2p + 1$ as a rate of change.)
6. Display the sequence of towers shown at right, and ask students to draw the next 3 towers. Ask how many blocks are in the tower #15. Ask them to draw tower #0 and describe it. (Note: Part of tower #0 is “underground”—i.e., two floors are in the basement. Ask, “What is the rate of change from tower to tower?”
7. Reverse the order of the towers, putting the 10-block tower first, then the 7-block tower, and so on. Ask, “What is the rate of change now?”



PART 2: MOVING TOWARD THE CARTESIAN PLANE AND THE EQUATION OF A LINE

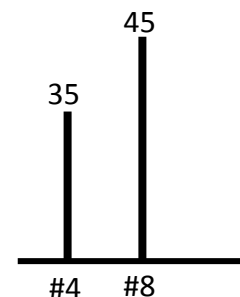
1. Because students usually have difficulty giving meaning to an ordered pair, capitalize on the towers model. Display the sequence of towers shown at right, telling students that because drawing all the blocks of these towers is cumbersome, each tower can be drawn simply as a “stick” with the number of blocks it represents written at the top. Ask, “What is the height of the tower #10? What is the height of the tower #25? What is the height of tower #0?”
2. Ask, “If you know the pattern number, can you write a formula that will give you the height of any tower?” Guide students to determine the rate of change in the heights of the towers to find the height of tower #0 and then put these elements together to get the formula: height of the tower #0 + (pattern # · rate of change) = number of blocks in the tower. (Note: This formula, which is a symbolic representation of the pattern, grows out of student thinking about such different graphical representations as towers of blocks, sticks, and so on.)
3. Have students answer the same questions about a sequence of the following towers: 11, 8, 5.



PART 3: MOVING TOWARD A RATE OF CHANGE

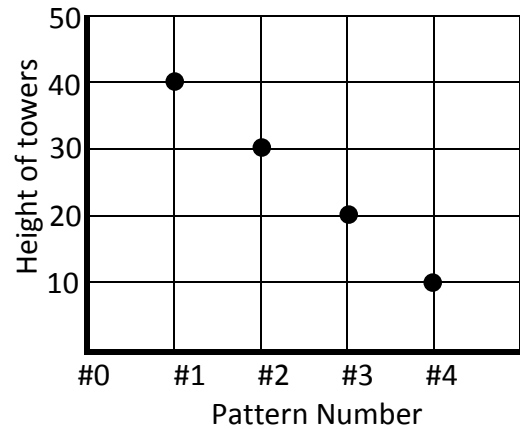
Move to tasks in which students cannot figure out the rate of change by comparing the heights of consecutive towers.

1. Display the sequence of towers shown at right, and ask, “What is the height of tower #5?” Guide students to see that the change in the height of the towers is 10, and tower #8 is 4 towers beyond tower #4. $10 \div 4 = 2.5$ blocks per tower, which is the rate of change. Therefore, $35 + 2.5 = 37.5$, which is the height of tower #5.
2. Ask, “What is the height of tower #12?” Have students work the problem and share their solutions.

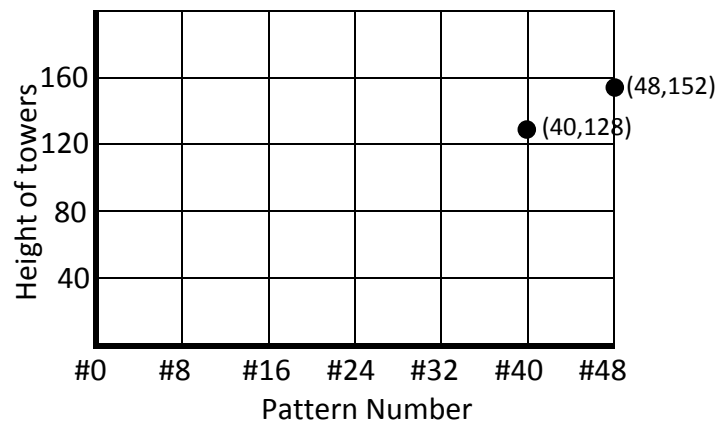


PART 4: INTERPRETING POINTS IN THE CARTESIAN PLANE

1. The next step is to interpret the towers as points in a plane. Instead of drawing sticks to represent the heights of the towers, show students how to use a grid to indicate the heights and the pattern numbers, as shown at right.
2. Ask, “How can we discover a formula that relates the height of the tower and the pattern number?” (Note: Students may again use the strategy of first determining the change in tower height and then working back to the height of the tower #0 by repeated addition or subtraction. We want them to move beyond repeated addition or subtraction to learn the height of tower #0. Therefore, we give them patterns in which that method is too cumbersome in order to push them toward a different strategy.)

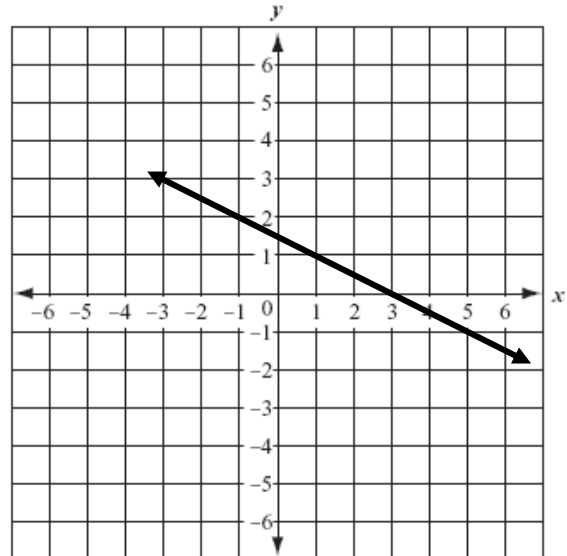
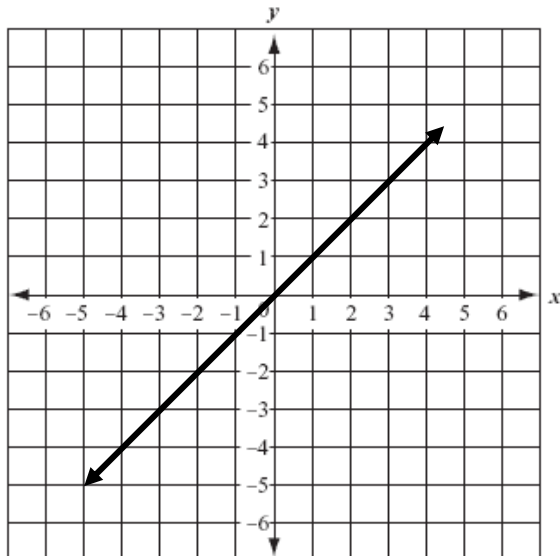


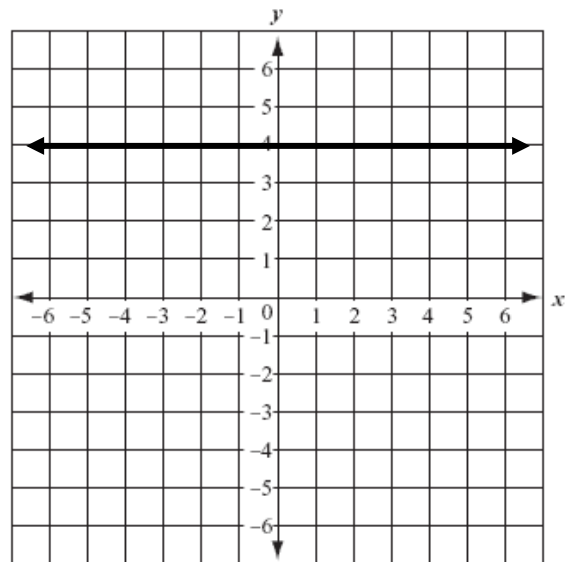
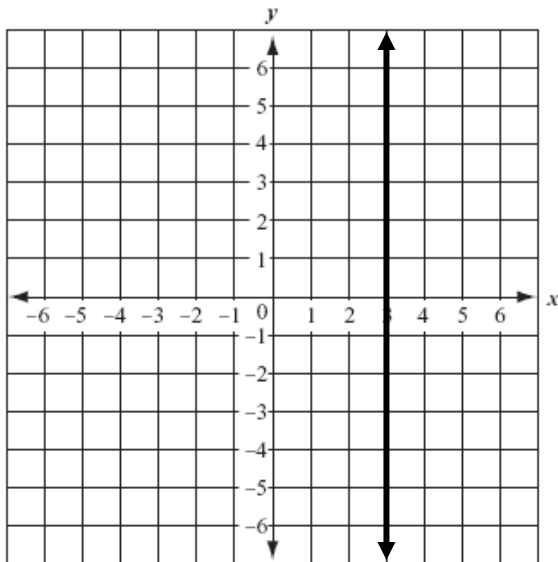
3. For example, display the plane and points shown at right, in which the heights of towers 40 and 48 are given. Have students use this data to find the rate of change. $[(152 - 128) \div 8 = 24 \div 8 = 3.]$ Tell students that to get back to tower #0, they would have to subtract 3 40 times. Obviously, it would be much easier to subtract 3×40 , or 120. Therefore, $128 - 120 = 8$, which is the height of the tower #0.



PART 5: COMPUTING SLOPE

1. Have students look at the graphs below and compute the slope for each.





Assessment

- **Questions**

- Given that tower #50 is 20 ft. tall and tower #75 is 145 ft. tall, what is the rate of change?
- How did you find the rate of change?
- How tall would tower 120 be, keeping the same rate of change?
- How tall would tower 15 be, keeping the same rate of change? Is this possible? Why, or why not?

- **Journal/Writing Prompts**

- One of your classmates was absent when we did this activity. How would you explain to the absent student how to find the rate of change?

- **Other**

- Give students a tower problem that has a rate of change of -5 . Explain why the rate is negative, and then have them solve the problem.

Extensions and Connections (for all students)

- Take a field trip to a construction site to calculate the rise-over-run of housetops. Have students pay extra attention to run-off and field drains.
- Have students measure the rise and run of different sets of stairs in the building.
- Work with a technical education class to enable students to apply what they are learning.

Strategies for Differentiation

- Provide students with a copy of the problems and questions to use as a visual reference.
- Allow concrete learners to benefit from making the models, using linking blocks.
- Provide copies of the graphs in Part 4 in sheet protectors so students can draw in the rates of change with dry erase markers.
- Share the following poem, or encourage students to create their own:

*The rate of change was never the same,
Even when called by its own name,
On simple days, he was quite easy,
Multiply by 2 equals 4, 6, 8, "Greasy!"*

*Well, what about the days when it's not that simple
Do I stress all day, till I get a pimple?
I'll tell you the secret: it's rise over run,
Now isn't this easy, isn't it fun?*

*It's not that hard when it looks so strange,
Just find all the numbers, then rearrange.
The difference in y over the difference in x ,
Now add in your last number to find out what's next.*